POPULATION STATUS OF MONGOLIAN ARGALI *OVIS AMMON* WITH REFERENCE TO SUSTAINABLE USE MANAGEMENT[1]

Michael R. Frisina[2], Yondon Onon[3] and R. Margaret Frisina[4]

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[2]Montana Department of Fish, Wildlife & Parks, 1330 West Gold Street, Butte, MT 59701. Email: habitat@bresnan.net
[3]Institute of Biology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia. Email: mpo.species@wwf.mn
[4]Member, Rocky Mountain Outdoor Writers and Photographers, 1330 West Gold Street, Butte, MT 59701. Email: habitat@bresnan.net

Using repeatable protocols, a survey of Argali sheep (*Ovis ammon*) in Mongolia was conducted across their range during November 2002. A country-wide population of 20,226 was estimated. Approximately 7% of Mongolia's 34,873 sq. km Argali range was surveyed. This was Mongolia's first repeatable survey for monitoring purposes. Other population estimates have been made, but the survey protocols were not given, making them unrepeatable and unusable for monitoring population trend. Population trend was established for a number of specific survey sites by comparing data collected during this survey with those done earlier in which the protocols were described. Population levels in some areas were depressed while in other areas population trend was stable or increasing. If the Mongolian Government implements a country-wide and site-specific Argali sustainable use management plan, potentially between 202-404 trophy rams could be harvested annually.

Key words: Argali, *Ovis ammon*, national population status, wild sheep, Mongolia, harvest quota

INTRODUCTION

Argali (*Ovis ammon*) wild sheep occur throughout central Asia, including Mongolia's steppe, undulating desert, and rugged mountainous landscapes (Valdez 1982; Geist 1991; Mitchell and Frisina 2007). Although their ranges are not well-defined, and some overlap may occur, Shackleton and Lovari (1997) are among those who recognize two subspecies of Argali as occurring in Mongolia: the Altai Argali (*O.a. ammon*) of western Mongolia, and the Gobi Argali (*O.a. darwini*) of the Gobi Desert in southern Mongolia. Both are listed as rare by the Mongolian Government (MNEM 1997), and are included in the United States Fish and Wildlife Service list of endangered and threatened wildlife and plants (USFWS 1997). In addition, they are listed as vulnerable and endangered by the IUCN (2000) and in Appendix II of CITES (USFWS 2001).

Mongolia, a central Asian landlocked country, encompasses about 16,56,000 sq. km of which *c.* 25% is potential Argali habitat (ASM 1990). Limited international sport hunting has been permitted since 1968. The current Mongolian law on hunting, established in 1995 and administered by the Mongolian Ministry for Nature and the Environment, regulates the commercial use of wildlife. Hunting fees are an important source of foreign currency in a badly depressed economy (MNEM 1995; Wingard and Purevdolgor 2001).

Argali populations are believed to have declined in Mongolia and throughout central Asia during the last century (Harper 1945; Mallon 1985; Heptner *et al.* 1989; Mallon *et al.* 1997; Reading *et al.* 1997). Specific and comparable country-wide population status and trend information for this species, a fundamental requirement for conservation (Wegge 1997), is lacking. Our paper provides an Argali population estimate for Mongolia. While other estimates have been published (Amgalanbaatar *et al.* 2001), ours is the first estimate determined through clearly defined field survey protocols and estimate calculation. Our estimate is repeatable for future surveys, and thus suitable for monitoring Argali population trend in Mongolia. We also discuss recent population trends at a number of specific survey sites and provide recommendations for applying our data to sustainable use of Argali.

STUDY AREA

Our study area encompassed the entire Mongolian Argali range, including the 2,435 sq. km Argali habitat in which the population surveys were conducted (Fig. 1). The Argali range in Mongolia is diverse, ranging from alpine communities in the Altai Mountains in western Mongolia, to steppe and desert communities in central and eastern Mongolia. Plant communities in Mongolia are diverse and typical of the central Asian plateau (Hilbig 1995; Gunin *et al.* 1999). Several of our survey sites were previously described in detail (Frisina and Boldbaatar 1998; Frisina and Gombosuren 1999; Frisina and Gombosuren 2000; Frisina *et al.* 2004).

Mongolia's climate is characterized by long, cold winters and short, humid summers. January is the coldest month with temperatures of -40° C or colder in contrast to >38° C during summer. Rainfall is highly variable, averaging 46 cm in the

Fig. 1: A schematic of Mongolia showing observation zones, survey site locations by number, and general area in which the Argali distribution is scattered (shaded gray). Survey sites areas follows: 1 = Buraat, 2 = Boorug Nuruu, 3 = Ahuunt, 4 = Ushgug, 5 = Ulanchulu, 6 = Darkhan, 7 = Togrug, 8 = Yurlug, 9 = Argiin Khad, 10 = Ik Nart, 11 = Choir

mountains and 10 cm in the Gobi Desert. The 1999-2000 winter was the most severe in 30 years and was preceded the previous summer by the most severe drought in 60 years (Tsend-Ayushin 2000). The climatic conditions of summer drought followed by severe winters continued through 2002 (Oyunbayar 2002; Horekens and Missiri 2002). During the 3-year period of 1999-2001, one third of Mongolia's domestic livestock (11 million) died due to these severe prolonged climatic conditions.

METHODS

Wild sheep were systematically surveyed at 11 sites within Mongolia's occupied Argali range (Fig. 1). The total area surveyed was 2,435 sq. km or *c.* 7% of Mongolia's occupied Argali range (34,873 sq. km). Occupied Argali range was determined by seeking Argali in the field during country-wide ground surveys conducted in 1993, 1997, 1998, 1999, 2001, and 2002. During these years we also interviewed local herders, hunting guides, game guards, and wildlife biologists about the distribution of Argali. Only those areas considered to be well established ranges, habitually used by Argali, were included. Many areas where Argali are only occasionally observed, or may occur only in very small numbers, were not included. Our Argali range estimate emphasizes the fall range used by wild sheep during the rutting season, the time of year they are most concentrated and readily observed for census purposes. Argali surveys done during summer or spring usually result in a relatively lower number of animals observed due to their being more widely dispersed and the adult males are in groups separate from the females.

Surveys were conducted on foot following ridgeline travel routes and from high observation points. Sheep were also observed by jeep during travel between observation points. Drop off points, base camp locations, and observation points were documented using GPS for future repetition. One observation group of 3 to 4 observers went into the field each day to observe Argali. Surveys were conducted during November 6-25, 2002, with 10 field days actually observing Argali; the remaining days were spent travelling between survey sites. Each of the 11 sites was surveyed systematically and as rapidly as conditions permitted to minimize double-counting animals. When the possibility existed that the same animals were observed more than once, only the first observation was recorded. Location and altitude at sheep sightings were recorded using a GPS.

Survey sites were chosen based on accessibility during November, their location within Mongolia's sheep range, and the availability of data collected during earlier surveys for trend comparison. We sought a representative sample from within each of the observation zones (Fig. 1). A selection of sites where hunting regularly occurs (Sites 1, 2, 3, 4, 6, 7, 8) were included in the survey (Fig. 1). Wegge (1997) emphasized the importance of surveying hunted populations.

Observed Argali densities were determined by dividing the number of animals seen by the size of the survey area. Each sheep observed was classified into one of the following categories: adult ewe, lamb, or ram. Rams were further

classified into age classes based on horn length (Geist 1966; Fedosenko *et al.* 1995) as follows: Class I (1-2 years old), Class II (3-4 years old), Class III (5-6 years old) and Class IV (>6 years old).

An estimate of argali population size was made by multiplying the average density of each zone by that zone's size (Fig. 1, Table 1). To adjust for size differences between zones, the number of argali estimated for each of the 3 zones was summed and divided by 34,873 sq. km (the total amount of occupied Argali habitat in Mongolia), which provided an adjusted density. The adjusted density was then multiplied by 34,873 sq. km for a November 2002 population estimate.

RESULTS AND DISCUSSION

Population Structure

A total of 1,085 Argali were observed during the survey, of which 1,054 were classified by sex and age. Ewes comprised 65% of Argali classified, lambs 19%, and rams 17%.

During the November 2002 survey 684 ewes and 196 lambs were counted, yielding a ratio of 29 lambs: 100 ewes, which is within the range of 10 to 63 lambs: 100 ewes reported for fall surveys by other authors (Frisina and Boldbaatar 1998; Frisina and Gombosuren 1999; Frisina *et al.* 2004). The ratio from this survey is similar to that reported for the Hangai Mountains (26.3) and higher than reported for Togrug in the south Gobi (13) during November 2000 surveys (Frisina and Onon 2000). Frisina and Onon (2000) concluded that these relatively low age ratios were likely the result of a severe winter the previous year followed by severe drought during summer 2000. Difficult weather conditions continued through 2002 with winter weather being particularly severe in the Hangai Mountains (Tsend-Ayushin 2000; Oyunbayar 2002; Horekens and Missiri 2002). Severe climatic conditions for a 3-year period immediately prior to our 2002 survey are likely the reason for the relatively low age ratios.

The 17% rams observed is slightly lower than the range of 21.5% to 37% reported by other authors for four fall surveys (Frisina and Gombosuren 1999; Frisina and Onon 2000). As with the depressed ewe: lamb ratio, the lower proportion of rams in 2002 is likely a result of winter mortality during the severe winters from 1991-2002 (Tsend-Ayushin 2000; Oyunbayar 2002; Horekens and Missiri 2002).

Of males, Class IV comprised the largest segment (45%), followed by Class III (28%), Class II (17%), and Class I (10%). Frisina and Gombosuren (2000) also reported Class IV rams as the largest male segment. However, the 45% observed during our survey is slightly lower than the range of 54.5% to 75% reported by Frisina and Gombosuren (1999), and Frisina and Onon (2000) for five fall surveys in Mongolia.

Table 1: Summary of observed Argali (*Ovis ammon*) density zonewise, November 2002

Zone	Zone Size (sq. km)	Argali Densities Avg. Density[1]	Range	Number of Survey Sites
West	25,046	0.11	0.02-0.17	3
North	2,646	0.51	0.47-0.8	3
South & East	7,181	2.24	32-5.78	5
Totals	34,873	1.19	0.02-5.78	11

[1] Number of Argali observed per sq. km

Population Size

For purposes of determining population size, Mongolia was divided into 3 zones: West Zone, North Zone, and South & East Zone (Fig. 1, Table 1). These divisions are based on differences in topography, access, and distribution of Argali that affect one's ability to sight Argali while conducting ground surveys. The West Zone includes the steep, rugged Altai Mountains, where Argali normally inhabit elevations as high as 3,600+ m. The Altai Argali habitat is a vast open landscape of interconnecting mountain ridges in which Argali are widely dispersed. Much of the Altai sheep range can only be accessed by foot and/or horseback; jeep access is very limited. The Altai Mountains have very little tree cover enabling Argali to spot potential predators from long distances. Thus, Argali survey efficiency is the most difficult in this zone, partially explaining why the lowest density (0.11 per sq. km) occurred in the Western Zone. Compared to the Western Zone, the Northern Zone is at lower elevation; the topography is less severe, and jeep access is less restricted. The Northern Zone includes the Ovorkhangai Mountains and is intermediate between the Western Zone and the South & East Zone for ability to survey Argali (0.51 per sq. km). The South & East Zone includes the vast Gobi Desert; it is the lowest in elevation, is the least severe in topography, and is highly accessible by jeep. Argali tend to concentrate within rocky areas or small mountain ranges with the desert during fall, and they tend to be more concentrated, making them more observable than within the other zones (2.24 per sq. km).

The adjusted density allowing for differences in size of the zones was 0.58 argali per sq. km. The adjusted density was used to calculate a November 2002 population estimate of 20,226 Argali for Mongolia. This is a conservative estimate; it only includes those specific areas determined to be well established Argali ranges. Areas of marginal habitat only occasionally used by Argali were excluded. The numbers of Argali counted per unit of area were assumed to be the total number inhabiting the area. Probably not all Argali within the

survey area were observed. Even aerial surveys underestimate population density (Pollock and Kendall 1987). When conducting fall surveys utilizing a helicopter, the most accurate census method, one can only expect to observe 20 to 50% of the population (Remington and Welsh 1989).

Population Trend

The country-wide population trend for Argali in Mongolia is unknown. Although a number of different population estimates (ranging from 10,000 to more than 50,000 Argali) have been made (Amgalanbaatar *et al.* 2001), the protocols have not been described, making comparison of estimates impossible. Establishing population trend for a number of specific survey sites is possible by comparing data collected during our survey with earlier surveys at sites in which the survey protocols were described. During surveys in the Western Zone (Altai Mountains – Khovd and Bayan Olgi Provinces) Frisina and Boldbaatar (1998) and Frisina and Gombosuren (2000) reported 27 and 24 Argali per day afield during July surveys in 1997 and 1999 respectively. During November 2002, 37 Argali were observed per day. Although the earlier surveys were conducted during July, they are comparable with the November 2002 survey because very little snow was present during November 2002; the weather during the survey was mild, and sheep were widely scattered at sites they typically use during July. Our findings indicate population trend at these sites within the Altai is up slightly or at least stable since 1997. During surveys in the Northern Zone (Ushgog – Ovorkhangai Province), Frisina and Gombosuren (1999) and Frisina and Yondon (2000) reported densities of 1.73 and 1 argali per sq. km during fall surveys in 1998 and 2000 respectively. During a survey of this same area during November 2002, 0.48 Argali per sq. km were observed, indicating population trend is down at Ushgig. During surveys in the South & East Zone (Ikh Nart – Dornogovi Province), Frisina and Gombosuren (1999) reported densities of 0.99 and 1.04 argali per sq. km for fall 1993 and 1998 respectively. During November 2002, 1.68 argali per sq. km were observed in this same area indicating population trend is up. At another location in the South & East zone (Togrug – Omnogobi Province), Frisina and Onon (2000) reported a density of 3 Argali per sq. km during a November survey in 2000. The survey of this same area during November 2002 yielded 1.71 Argali per sq. km, indicating population trend at Togrug may be down.

CONCLUSIONS AND RECOMMENDATIONS

Comparing this survey with previous surveys by Frisina and Boldbaatar (1998), Frisina and Gombosuren (2000), Frisina and Onon (2000), and Frisina *et al.* (2004) indicates population levels in some areas are depressed while in other areas population trend is stable or increasing. The moderate percentage of rams observed (45%) and low proportion of lambs observed (29 lambs: 100 ewes) is reflective of several years in succession of severe summer drought followed by harsh winters (Tsend-Ayushin 2000; Oyunbayar 2002; Horekens and Missiri 2002). If Argali populations were experiencing a catastrophic event, such as a disease epidemic, high mortality would be expected to occur across all age classes, not primarily with lambs and older males as experienced during this survey. The relative abundance of older rams in the population (Class III and Class IV) indicates trophy hunting has not been excessive.

As part of an overall plan for sustainable use management similar to that described by Frisina and Gombosuren (2000), and following recommendations of Harris (1993), the estimated population of 20,226 Argali in Mongolia could potentially sustain a trophy harvest of 202-404 rams annually. Harris (1993) indicated 1-2% of the total population may be safely harvested annually without negative consequences. To accurately monitor population trend and maintain sustainable harvest quotas it is important that Argali population trend be monitored through repeating the protocols established by this survey once every 3 to 5 years.

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